THE VALIDITY OF THE LINEARITY ASSUMPTION OF SOIL-TO-PLANT TRANSFER FACTORS IN BOREAL FOREST

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In radioecological modelling, plant uptake of radionuclides is commonly described by a transfer factor (TF) which is calculated by dividing the concentration in plant by the concentration in soil. The use of the traditional TFs requires the assumption that the plant and soil concentrations are linearly related. However, it has been found that this linearity assumption does not hold for essential elements and it has been questioned also for non-essential elements. In this study the linearity of the TFs of lead, molybdenum, nickel, uranium and zinc from soil to boreal forest plant species was investigated. The study was conducted at two forest sites in Eastern Finland. The collected plant species were May lily (*Maianthemum bifolium*), narrow buckler fern (*Dryopteris carthusiana*), blueberry (*Vaccinium myrtillus*), rowan (*Sorbus aucubaria*) and Norway spruce (*Picea abies*). The understory samples were divided into root, stem/petiole and leaf fractions. Both coarse and fine roots were collected from trees in addition to leaves/needles. Pseudototal concentrations of Mo, Ni, Pb, Zn and U in plants and soil were measured by ICP-MS. An estimate of the mobile fraction of these elements in forest soil was measured by ICP-MS after 1 M ammonium acetate (pH 4.5) leach. When TFs were represented as the function of soil concentration, a trend of higher TFs at lower soil concentrations was clearly seen for all elements and plant species. A non-linear function fitted to the data showed higher R^2-values than the linear fit. This was true for both TFs based on total soil concentrations and TFs based on mobile soil concentrations. The use of constant TFs may lead to underestimation of plant concentrations, especially in the case of low soil concentrations. Part of the large variation of empirically determined TFs may be systematic variation with soil concentrations. Thus, introducing non-linearity into radioecological modelling could improve the quality of modelling.